What is Claimed:

1. A laser micromachining system for drilling holes in a work piece comprising:

a laser beam generator for directing a laser beam having a wavelength λ, along an optical path,

an image interpolating mask having an array of apertures, disposed in the optical path, for receiving the laser beam and forming a corresponding array of sub-beams of a first pitch size,

a translation stage configured to move the array of sub-beams in a perpendicular direction to the optical path, and

a demagnifier, disposed in the optical path, for forming a reduced-size pattern of the array of sub-beams on the work piece, the reduced-size pattern having a second pitch size,

wherein the second pitch size is less than λ and the first pitch size is greater than λ, and

when the laser beam is generated and the translation stage moves the array of sub-beams, the image interpolating mask is effective in forming an array of holes having the second pitch size.

2. The laser micromachining system of claim 1 wherein

the array of sub-beams formed by the image interpolating mask is a sub-pattern of the reduced-size pattern formed on the work piece, and

the translation stage is configured to move the array of sub-beams in a sequence to form the reduced-size pattern on the work piece.

3. The laser micromachining system of claim 2 wherein

the translation stage is coupled to the image interpolating mask for moving the image interpolating mask and the array of sub-beams.

4. The laser micromachining system of claim 2 wherein

the translation stage is coupled to a work piece holder holding the work piece for moving the work piece with respect to the array of sub-beams.

5. The laser micromachining system of claim 1 wherein

the array of apertures of the image interpolating mask has an aperture density of 1/N times an image density of the reduced-size pattern on the work piece and times a demagnification factor of the demagnifier, N being a positive integer, and

the array of sub-beams is configured to translate N-times in a perpendicular direction to the optical path by the translation stage to form the array of holes of the second pitch size.

6. The laser micromachining system of claim 1 wherein

the laser beam generator includes a pulsed laser providing a pulsed-on period of less than 200 femtoseconds, and

a harmonic generating crystal, coupled to the pulsed laser, for providing a harmonic frequency of the pulsed laser to produce the laser beam having the wavelength of λ.

7. The laser micromachining system of claim 1 wherein

the demagnifier includes a first lens having a first focal length and a microscope objective having a second focal length, and

a demagnification factor resulting from the first focal length divided by the second focal length.

8. The laser micromachining system of claim 1 wherein

each of the sub-beams includes a Gaussian intensity distribution, and

a hole of the array of holes has a diameter of approximately less than or equal to the full width at half maximum (FWHM) of the Gaussian intensity distribution.

9. The laser micromachining system of claim 1 wherein

a scanning mirror is provided in the optical path behind the laser beam generator for uniformly distributing the laser beam onto the image interpolating mask.

10. The laser micromachining system of claim 1 wherein

the second pitch size is less than a diffraction limit of the laser beam, and

the first pitch size is greater than the diffraction limit of the laser beam multiplied by a demagnification factor of the demagnifier.

11. A laser micromachining system for drilling holes in a work piece comprising:

a laser beam generator for directing a laser beam along an optical path, the laser beam having a wavelength of λ,

a diffraction optical element (DOE) and a telecentric f-θ lens disposed in the optical path for receiving the laser beam and forming an array of sub-beams, the array of sub-beams having a first pitch size,

a translation stage configured to move the array of sub-beams in a perpendicular direction to the optical path, and

a demagnifier for forming a reduced-size pattern of the sub-beams onto the work piece, the reduced-size pattern having a second pitch size,

wherein the second pitch size is less than λ and the first pitch size is greater than λ, and

when the laser beam is generated and the translation stage moves the array of sub-beams, the DOE and the telecentric f-θ lens are effective in forming an array of holes having the second pitch size.

12. The laser micromachining system of claim 11 wherein

the array of sub-beams formed by the DOE and the telecentric f-θ lens are a sub-pattern of the reduced-size pattern formed on the work piece, and

the translation stage is configured to move the array of sub-beams in a sequence to form the reduced-size pattern on the work piece.

13. The laser micromachining system of claim 12 wherein

the translation stage is coupled to the telecentric f-θ lens for moving the telecentric f-θ lens and the array of sub-beams.

14. The laser micromachining system of claim 12 wherein

the translation stage is coupled to a work piece holder holding the work piece for moving the work piece with respect to the array of sub-beams.

15. The laser micromachining system of claim 11 wherein

the array of sub-beams has a density of 1/N times an image density of the reduced-size pattern on the work piece and times a demagnification factor of the demagnifier, N being a positive integer, and

the array of sub-beams is configured to translate N-times in a perpendicular direction to the optical path by the translation stage to form the array of holes of the second pitch size.

16. The laser micromachining system of claim 11 wherein

the laser beam generator includes a pulsed laser providing a pulsed-on period of less than 200 femtoseconds, and

a harmonic generating crystal, coupled to the pulsed laser, for providing a harmonic frequency of the pulsed laser to produce the laser beam having the wavelength of λ.

17. The laser micromachining system of claim 11 wherein

each of the sub-beams includes a Gaussian intensity distribution, and

a hole of the array of holes has a diameter of approximately less than or equal to the full width at half maximum (FWHM) of the Gaussian intensity distribution.

18. The laser micromachining system of claim 11 wherein

a scanning mirror is provided in the optical path behind the laser beam generator for uniformly distributing the laser beam onto the DOE.

19. The laser micromachining system of claim 11 wherein

the second pitch size is less than a diffraction limit of the laser beam, and

the first pitch size is greater than the diffraction limit of the laser beam multiplied by a demagnification factor of the demagnifier.

20. A laser micromachining system for drilling holes in a work piece comprising:

a laser beam generator for directing a laser beam having a wavelength λ, along an optical path,

an image interpolating mask having an array of apertures, disposed in the optical path, for receiving the laser beam and forming a corresponding array of sub-beams of a first pitch size,

a translation stage configured to move the array of sub-beams in a perpendicular direction to the optical path, and

a demagnifier, disposed in the optical path, for forming a reduced-size pattern of the array of sub-beams on the work piece, the reduced-size pattern having a second pitch size,

wherein the second pitch size is less than a diffraction limit of the laser beam, and the first pitch size is greater than the diffraction limit of the laser beam, and

when the laser beam is generated and the translation stage moves the array of sub-beams, the image interpolating mask is effective in forming an array of holes having the second pitch size.

21. The laser micromachining system of claim 20 wherein

the second pitch size is approximately equal to a Rayleigh distance of $0.61*\lambda/N.A.$, where N.A. is a numerical aperture of a lens in the optical path.

22. The laser micromachining system of claim 21 wherein

the second pitch size is approximately equal to 1.5* Rayleigh distance.

23. A laser micromachining system for drilling holes in a work piece comprising:

a laser beam generator for directing a laser beam along an optical path, the laser beam having a wavelength of λ,

a diffraction optical element (DOE) and a telecentric f-θ lens disposed in the optical path for receiving the laser beam and forming an array of sub-beams, the array of sub-beams having a first pitch size,

a translation stage configured to move the array of sub-beams in a perpendicular direction to the optical path, and

a demagnifier for forming a reduced-size pattern of the sub-beams onto the work piece, the reduced-size pattern having a second pitch size,

wherein the second pitch size is less than a diffraction limit of the laser beam, and the first pitch size is greater than the diffraction limit of the laser beam, and

when the laser beam is generated and the translation stage moves the array of sub-beams, the DOE and the telecentric f-θ lens are effective in forming an array of holes having the second pitch size.

24. The laser micromachining system of claim 23 wherein

the second pitch size is approximately equal to a Rayleigh distance of 0.61*λ/N.A., where N.A. is a numerical aperture of a lens in the optical path.

25. The laser micromachining system of claim 24 wherein

the second pitch size is approximately equal to 1.5* Rayleigh distance.

26. A method of drilling holes in a work piece comprising the steps of:

(a) receiving a laser beam directed along an optical path;

(b) directing the laser beam through a beam former, disposed in the optical path, to form an array of sub-beams of a first pitch size;

(c) demagnifying the array of sub-beams to form a reduced-size pattern of a second pitch size on the work piece;

(d) translating the array of sub-beams in a perpendicular direction to the optical path; and

(e) after translating the array of sub-beams in the perpendicular direction to the optical path, forming the reduced-size pattern of the second pitch size on the work piece.

27. The method of claim 26 wherein

step (a) includes receiving the laser beam having a wavelength of λ;

step (b) includes forming the array of sub-beams with a pitch size greater than the wavelength of λ; and

step (e) includes forming the reduced-size pattern on the work piece with a pitch size smaller than the wavelength of λ.

28. The method of claim 26 wherein the first pitch size is larger than the second pitch size by a factor of P times a demagnification factor provided by the demagnifying step, P being a positive integer; and

step (d) includes translating the array of sub-beams in the perpendicular direction P times; and

step (e) includes after translating the array of sub-beams P times, forming the reduced-size pattern of the second pitch size on the work piece.

29. The method of claim 26 wherein

step (b) includes directing the laser beam through an image interpolating mask having an array of apertures, and

forming the array of sub-beams after passing the laser beam through the array of apertures.

30. The method of claim 26 wherein

step (b) includes directing the laser beam through a DOE and a telecentric f-θ lens, and

forming the array of sub-beams after passing the laser beam through the DOE and the telecentric f-θ lens.

31. The method of claim 30 including

after directing the laser beam through the DOE, forming an angled beam pattern; and

forming the array of sub-beams into a parallel pattern by passing the angled beam pattern through the telecentric f-θ lens.

32. The method of claim 26 wherein the array of sub-beams has a density of 1/N times an image density of the reduced-size pattern on the work piece and times a demagnification factor of the demagnifying step, N being a positive integer; and

step (d) includes translating the array of sub-beams N times in the perpendicular direction to the optical path; and

step (e) includes after translating the array of sub-beams N times, forming the reduced-size pattern on the work piece.

33. The method of claim 26 wherein

step (d) includes coupling a translation stage to the beam former for translating the array of sub-beams in the perpendicular direction to the optical path.

34. The method of claim 26 wherein

step (d) includes coupling a translation stage to a work piece holder for translating the array of sub-beams in the perpendicular direction with respect to the optical path.